CLAIMS

What is claimed is:

1. A semiconductor PIN Mach-Zehnder modulator for modulating an optical signal with an RF signal, said optical signal having a carrier frequency, said modulator comprising:

a substrate;

a first PIN device formed on the substrate and including a P-type layer, an intrinsic layer and an N-type layer, said intrinsic layer including a quantum dot structure;

a second PIN device formed on the substrate and including a P-type layer, an intrinsic layer and an N-type layer, said intrinsic layer including a configuration of quantum dot structure;

a Mach-Zehnder interferometer including a first optical path and a second optical path, said intrinsic layer of the first PIN device being positioned in the first optical path and said intrinsic layer of said second PIN device being positioned in the second optical path; and

a biasing system, said biasing system including a first DC bias source applying a first DC bias signal to the intrinsic layer of the first PIN device, a second DC bias source providing a second DC bias signal to the intrinsic layer of the second PIN device, and an RF signal source providing the RF signal in phase to the intrinsic layers of the first and second PIN devices.

2. The modulator according to claim 1 wherein the first and second DC bias sources provide different DC bias signals to the first and second PIN devices.

3. The modulator according to claim 1 wherein the quantum dot structure in the first and second PIN devices are nearly identical.

4. The modulator according to claim 1 wherein the quantum dot structure in the first and second PIN devices are different and the first and second DC bias sources provide the same DC bias to the first and second PIN devices.

5. The modulator according to claim 1 wherein the modulator is an analog modulator that intensity modulates the optical signal with the amplitude of the RF signal.

6. The modulator according to claim 1 wherein the first and second DC bias signals provide an operational energy level on opposite sides of an energy density state of the quantum dot structures.

7. The modulator according to claim 6 wherein the energy density state is determined relative to the carrier frequency of the optical signal.

8. A semiconductor PIN modulator for modulating an optical signal with an RF signal, said optical signal having a carrier frequency, said modulator comprising:

a substrate; and

a first PIN device formed on the substrate and including a P-type layer, and intrinsic layer and an N-type layer, said intrinsic layer including a quantum dot structure.

9. The modulator according to claim 8 further comprising a second PIN device formed on the substrate and including a P-type layer, intrinsic layer and an N-type layer, said intrinsic layer of the second PIN device including a quantum dot structure, said first PIN device being positioned within a first arm of a Mach-Zehnder interferometer and said second PIN device being positioned within a second arm of the Mach-Zehnder interferometer.

10. The modulator according to claim 9 further comprising a biasing system, said biasing system including a first DC bias source applying a first DC bias signal to the intrinsic layer of the first PIN device, a second DC bias source applying a second DC bias signal to the intrinsic layer of the second PIN device, and an RF signal source providing the RF signal in phase to the intrinsic layers of the first and second PIN devices.

11. The modulator according to claim 10 wherein the first and second DC bias sources provide different DC bias signals to the first and second PIN devices.

12. The modulator according to claim 9 wherein the quantum dot structures in the first and second PIN devices are about the same.

13. The modulator according to claim 9 wherein the quantum dot structures in the first and second PIN devices are different and the first and second DC bias sources provide the same DC bias to the first and second PIN devices.

14. A method of modulating an optical signal with an RF signal, said optical signal having a carrier frequency, said method comprising:

providing a first PIN device formed on a substrate, said first PIN device including a P-type layer, an intrinsic layer and an N-type layer, said intrinsic layer including a quantum dot structure;

propagating the optical signal through the first PIN device; and

applying the RF signal to the intrinsic layer of the first PIN device.

15. The method according to claim 14 further comprising providing a second PIN device formed on the substrate, said second PIN device including a P-type layer, and intrinsic layer and an N-type layer, said intrinsic layer of the second PIN device including a quantum dot structure, propagating the optical signal through the second PIN device and applying the RF signal to the intrinsic layer of the second PIN device.

16. The method according to claim 15 further comprising applying a first DC bias potential to the first PIN device and providing a second DC bias signal to the second PIN device.

17. The method according to claim 16 wherein the first and second DC bias signals are different.

18. The method according to claim 15 wherein the quantum dot structures in the first and second PIN devices are nearly identical.